Mitt. Bayer. Staatsslg. Paläont. hist. Geol.	38	259–273	München, 15. 12. 1998

Euphorbioxylon ortenburgense n. sp. from the East Bavarian Molasse with disjunctive ray cell walls

Euphorbioxylon ortenburgense n. sp. aus der ostbayerischen Molasse mit disjunktiven Holzstrahl-Zellwänden

By Alfred Selmeier*)

With 11 text-figures and 2 tables

Abstract

In Tertiary sediments from the northalpine Molasse basin thousands of silicified wood pieces have been collected in the last decades. The new fossil, *Euphorbioxylon ortenburgense* n. sp., is the first record of the family Euphorbiaceae in the miocene gravel-belt of Ortenburg (East Bavarian Molasse). A conspicuous microscopic feature of the fossil are disjunctive ray parenchyma cells, partially disjoined but with contacts maintained through tubular or complex wall processes (IAWA list 1989; feature 113). It is the first record of this extremely rare feature in a Tertiary silicified wood.

Kurzfassung

Zahlreiche mit dem „Ortenburger Schotter" transportierte Kieselhölzer sind aufgrund ihrer xylem-anatomischen Struktur als zwingend „tropisch" einzustufen (Gottwald 1997). Mit *Euphorbioxylon ortenburgense* n. sp. ist erstmals die Familie Euphorbiaceae holzanatomisch nachweisbar. Rezent sind die Euphorbiaceae (290 Gattungen, 7500 Arten) vorwiegend in tropischen Gebieten verbreitet. Der Fossilrest zeigt ein mikroskopisches Merkmal, das selbst bei heutigen Gehölzen äußerst selten ist. Es sind disjunktiv gewachsene Holzstrahl-Zellwände. Dieses eigenartige Merkmal ist unter 342 holzbildenden Familien auf nur 7 beschränkt. Innerhalb dieser 7 Familien sind es jeweils nur wenige Gattungen. Erstmals ist dieses Merkmal (IAWA list 1989; feature 113) an einem tertiären Kieselholz nachweisbar.

Introduction

The wood sample described in this paper was found in the lower miocene gravel-belt of the East Bavarian Molasse, Germany. The sand and gravel pits in the Bavarian „Ostmolasse", especially the locality Rauscheröd, is rich in quantity and diversity of fossil woods (Gottwald

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1997; Gregor 1982; Selmeier 1985, 1986, 1989, 1998). The first published microanatomical identification of these woods resulted in the genera *Bombacoxylon* (Bombacaceae), *Carapoxylon* (Meliaceae) and *Grewioxylon* (Tiliaceae). More than 250 wood specimens from Rauscheröd, partly long logs, are deposited in the Bavarian State Collection of Palaeontology and historical Geology, Munich (Collection R. Baumgartner).

Anatomical description

Euphorbiaceae

Euphorbioxylon (Felix) Mädel 1962

Euphorbioxylon Felix 1887

D i a g n o s i s : Gefäße gleichmäßig verteilt, einzeln oder in radialen Gruppen angeordnet, Durchbrechungen einfach, Tüpfel alternierend, zu den Markstrahlzellen vergrößert; Libriformfasern nicht septiert; Holzparenchym sehr reichlich, apotracheal-diffus, häufig Kristalle in gekammerten Zellen; Markstrahlen 1- bis 5-reihig, bis über ein 1 mm hoch, stark heterogen, in den Zellen häufig Kristalle.

Euphorbioxylon speciosum Felix 1887 emend Mädel 1962

1887 *E. speciosum*, Felix 1887, p. 522, pl. 25, fig. 4 and 6-7
1962 *E. speciosum*, Mädel, p. 304-306, fig. 8.

E u p h o r b i o x y l o n o r t e n b u r g e n s e n. sp.

M a t e r i a l : One silicified specimen, 43 cm long, maximal diameter 17 cm; color reddish-brown with distinct wood structure; leg. Prof. W. Jung, Inv.-No. BSP 1964 I 486.

L o c a l i t y : Sand and gravel pit Rauscheröd near Ortenburg NW of Passau, map 1:25000 No. 7445 Ortenburg.

S t r a t i g r a p h i c p o s i t i o n : East Bavarian Molasse, Lower miocene gravel stream of the so-called „Ortenbuger Schotter"; according Heissig (1997, tab. p. 9) Mammal Neogene zone (MN 4b), OSM unit A, sedimentary cyclus O. Indications as to were the silicified woods originated are not available (Gottwald 1997: 5).

A g e : Lower miocene gravel stream „Ortenburger Schotter".

M i n u t e a n a t o m y
Fig. 1-11

The present description is based on 4 thin slides. The petrified wood consists of only secondary xylem without bark. It is in some regions poorly preserved. The decayed wood tissue obscures some critical anatomical features.

G r o w t h r i n g s

Indistinct or absent, partly invisible, faint, poorly defined boundaries by flattened latewood fibres and marked by a higher vessel frequency per square millimeter in early wood (Fig. 1-2), growth ring zones e.g. 1,8, 1,7, 1,5, 1,2, 1,9, 2,0, 2,0, 1,6 mm..

V e s s e l s

Diffuse-porous, solitary (95%), seldom multiples of 2-(3), vessels oval in outline (Fig. 2), tangential diameter 35- 56 -(68) µm, e.g. tangential 56 µm, radial 91 µm, vessel element length

50-161 (mean 90) µm, vessel perforations simple (Fig. 6), plates are generally horizontal to slightly declined, pits crowded (Fig. 7), alternate and probably vestured, aperture generally linear and usually horizontal, 5-6 µm, e.g. horizontal distance of 49 µm cell wall about 7-8 pits in tangential view. Vessel-ray pitting oval to elongated or gash-like, e.g. horizontal distance 14 µm, vertical 3 µm.

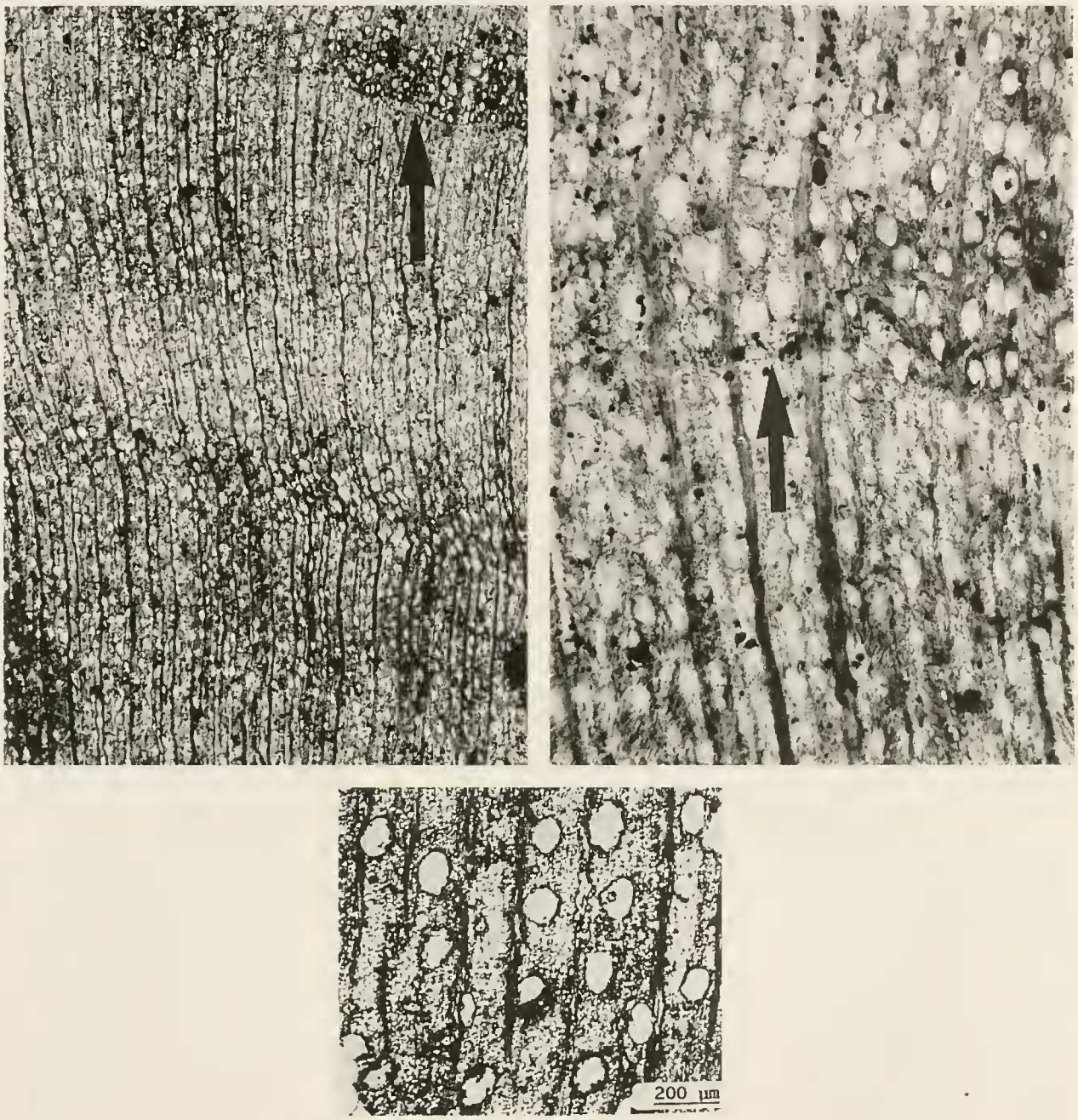

Fig. 1. Cross sections (BSP 1964 I 486). Diffuse porous wood with indistinct growth rings, marked by differences of vessel dimensions (arrows) - left x 20, right x 40 For comparison (below): *Euphorbioxylon speciosum* (Pons 1987).

Fibres

Ground tissue fibres occur continuously throughout the wood, not well preserved, oval to sligthly angular in cross-section, arranged in 2 - 7 rows between two rays, not thick-walled, without bordered pits, nonseptate.

Fig. 2. Cross section (BSP 1964 I 486). Diffuse porous wood with two indistinct growth ring boundaries (arrows), uni- and multiseriate dark rays and small, oval-shaped solitary vessels; x 45

Axial parenchyma

Absent or extremely rare, invisible due decayed wood tissue (?).

Rays

Uniseriate and 3-4(5)seriate, closely spaced and markedly heterocellular (KRIBS I, IIA; CARLQUIST 1988: 179, I-IIA); rays 300 µm - 3,4 mm high, a) uniseriate rays very few, consisting wholly of upright cells, e.g. 7-16 cells (560-980 µm) high, 17-19 µm in width; b) rays often composed with vertical uni- and multiseriate sections and 2- 3,4 mm high (Fig. 4-5), multiseriate rays with 3-4(5) cells (28-70 µm), e.g. 3seriate ray (35 µm) large and 8 cells (217 µm) high, 4seriate rays (63-70 µm) large, 19-31 cells (133-840 µm) high; procumbant ray cells in tangential section generally 25 µm high, upright cells 60 - 70 µm high; multiseriate rays with long marginal rows of uniseriate cells; some solitary crystals visible; disjunctive ray parenchyma cell walls present (Fig. 6-8, 10-11), abundant and well preserved, different microscopic view in tangential

or radial section, feature No. 113 (IAWA list 1989), visible only in the upright ray cells, not in the procumbant cells; 5 - 7 multiseriate rays per mm.

Features according IAWA list (1989): 2, 5, 9, 16, 22, 24, 29, 30, 41, 66, 70, 75, 97, 102, 108, 110, 113 (disjunctive ray parenchyma cell walls), 116.

Diagnosis

Growth rings: indistinct or vague, some regions with a lower vessel frequency, with smaller vessels accompanied by a change in fiber wall thickness. Vessels: Diffuse porous, the small pores evenly distributed, more than 95 % solitary, without radial multiples of 2-5, solitary vessels oval in outline, tangential diameter 35 - 56 µm, vessel frequency from 46 to 58 per sq. mm; perforation plates exclusively simple, vessel element lengths ranging from 50 - 161 µm, end walls horizontal, pits crowded alternate, 5 µm; vessel-parenchyma pits variable in outline, horizontally enlarged, gash-like, oval rounded, ? thin-walled, tyloses in the vessels. Fibres: Non-septate, no pits observed, thin- to thick-walled. Axial parenchyma: Indistinct, not clearly visible, absent to rare. Rays: Uniseriate rays with upright cells present, but not abundant, predominantly 3-4(5)seriate rays, all rays markedly heterocellular, multiseriate rays often vertically fusiform with some uni- and multiseriate sections, marginal rows with upright or oblique divided cells; disjunctive ray parenchyma cell walls abundant; 6-8 rays per mm.

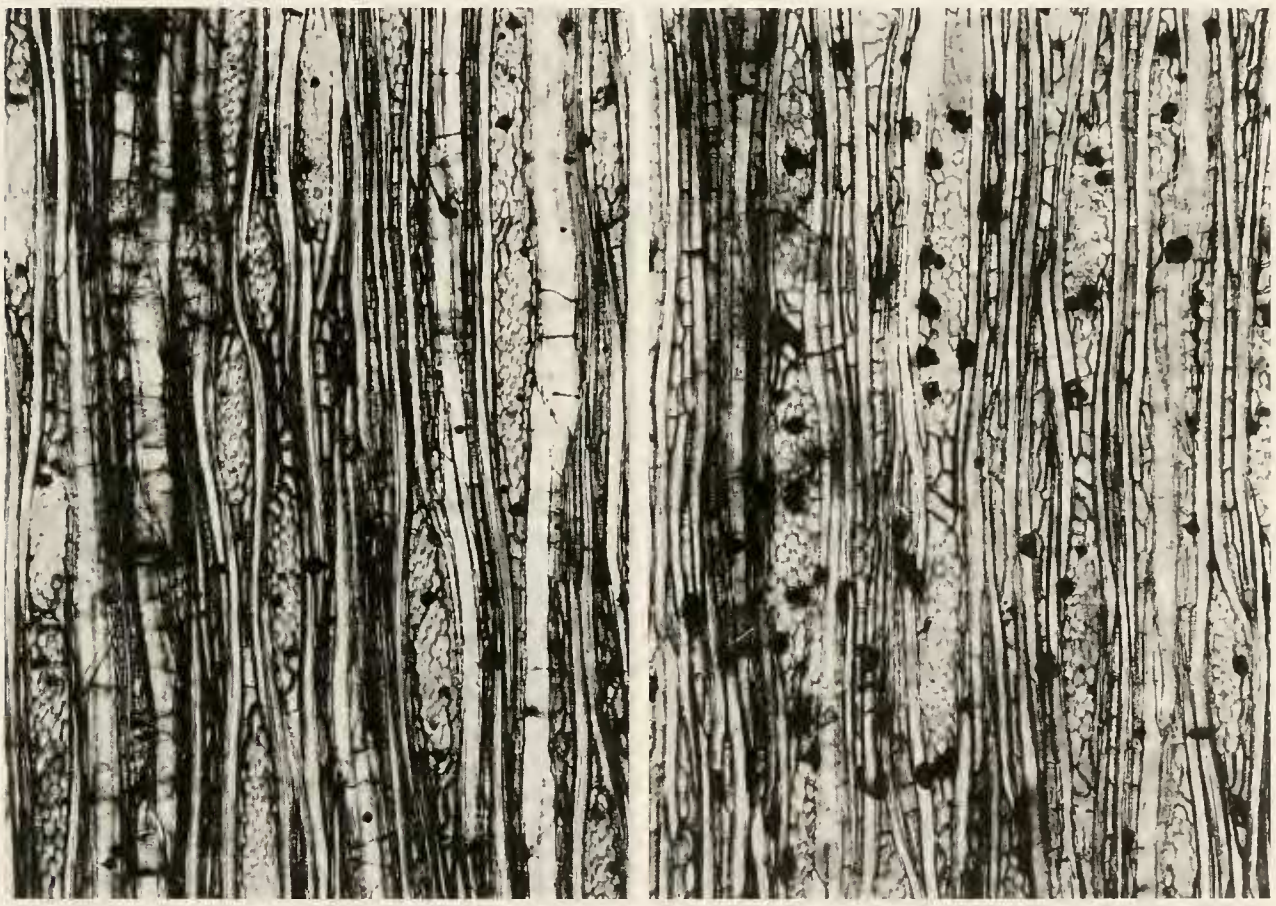

Fig. 3. Tangential sections (BSP 1964 I 486). Rays markedly heterocellular, composed often with uni- and multiseriate sections; left x 70, right x 70

Affinities

Comparison with extant woods

The types of extant wood with combinations of characters similar to the fossil wood were determined using family descriptions in „Anatomy of the Dicotyledons" (Metcalfe & Chalk, 1950) and other standard references: Brazier & Franklin (1961), Carlquist (1988), Gregory (1994), Ilic (1991), Jannssonius (1934), Kribs (1968), Miles 1978, Record (1938), Record & Hess (1943), Wagenführ & Scheiber (1985).

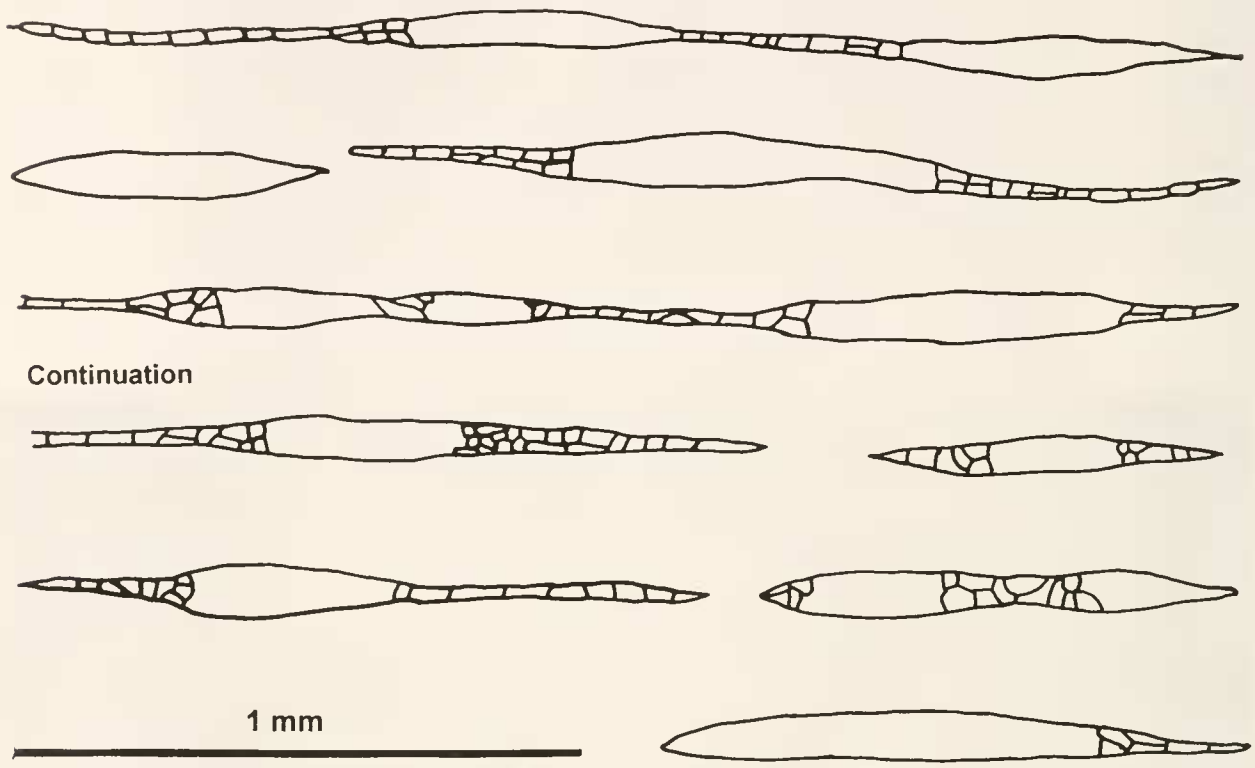

Fig. 4. Tangential section (BSP 1964 I 486). Typical forms of uni- and multiseriate rays

The combination of vessels solitary (not in short radial multiples), exclusively simple perforation plates, crowded alternate and ? vestured pits, enlarged gash-like vessel-ray parenchyma pitting, axial parenchyma absent or indistinct, fibres non-septate, rays distinct heterocellular, 1-4seriate, multiseriate rays up to 3,4 mm high, rays vertically often composed in uni- and multiserate sections occurs in a number of extant dicotyledonous families. But the feature „disjunctive ray parenchyma cell walls" in combination with all the above mentioned features is typically and only present in some genera of the Euphorbiaceae, Group B, *Crotonoideae* (Metcalfe & Chalk 1950, p.1223-1235). According to the IAWA list (1989) some Euphorbiaceae and other families have disjunctive ray parenchyma cell walls.

No extant wood could be find, neither in anatomical descriptions nor in the xylothec, which corresponds in all features with the present fossil wood from Rauscheröd.

Disjunctive ray parenchyma cell wall

The ray parenchyma cells are partially disjoined but with contacts maintained through tubular or complex wall processes (IAWA list 1989).

The ray cells appear to have pulled apart from each other prior to maturation and which therefore are interconnected to each other by fingerlike processes or other restricted points of

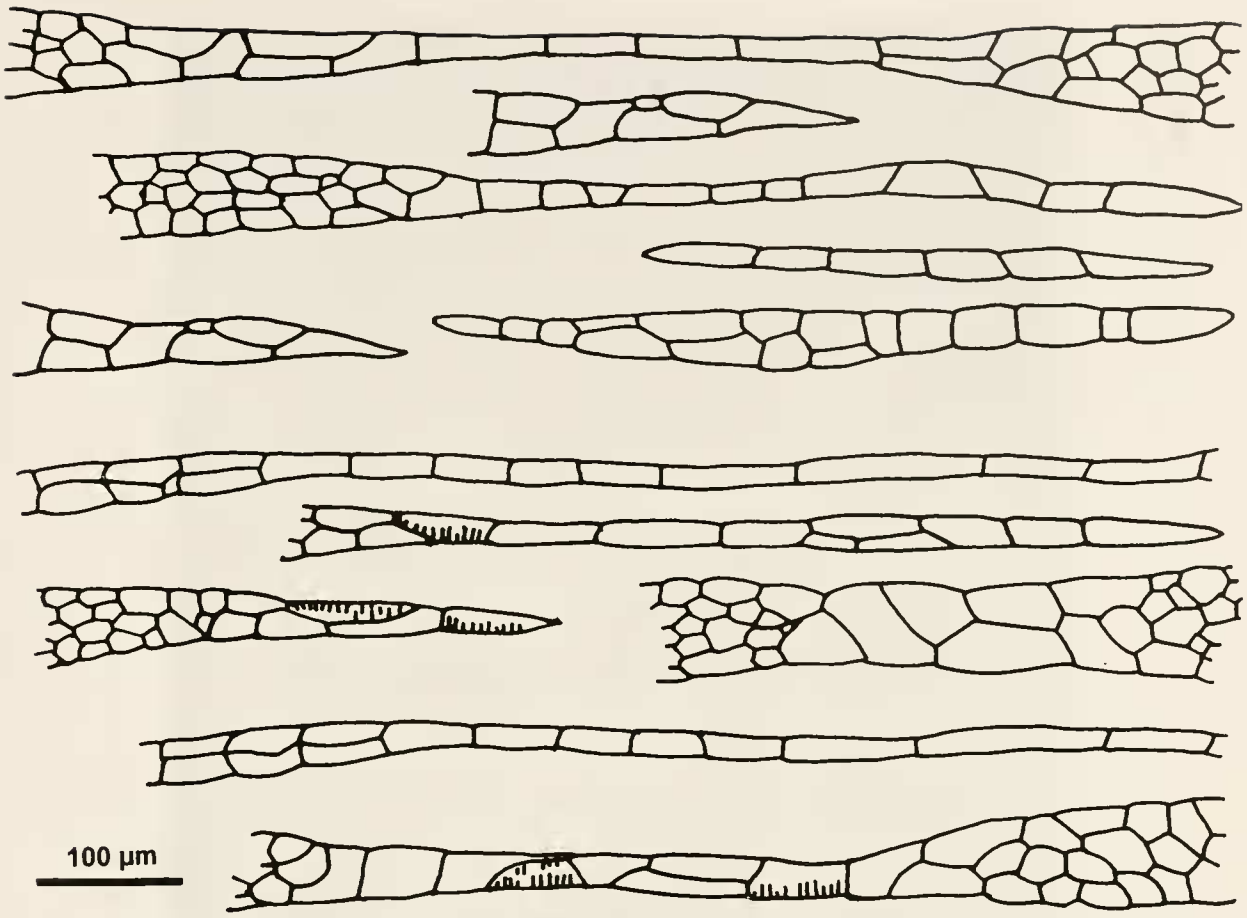

Fig. 5. Tangential section (BSP 1964 I 486). Typical forms of uni- and multiseriate rays.

contact (Carlquist 1988: 210-211). They have been reported in some genera of 7 families: Apocynaceae, Buxaceae, Euphorbiaceae (*Croton oligandrus*, *Glycidendron amazonicum*, *Suregada laurina*), Malpighiaceae, Myrtaceae, Rubiaceae, Sapotaceae.

Comparison with thin slides

Xylothec Dr. D. Grosser, Institute of Wood Research, University Munich, Stern's Index Xylariorum p.229-230 (Stern 1988):

Controlling all in Munich available thin slides of Euphorbiaceae (42 genera) in the xylothec, only *Sebastiana brasiliensis,* RAKF No. 9053, has distinct disjunctive ray parenchyma cell walls (Fig. 8). The author is grateful to Dr. D. Grosser, Munich, for help to find thin slides of a modern Euphorbiaceae with features No 113, IAWA list 1989.

S. brasiliensis (90 species), subfamiliy Euphorbioideae (Crotonoideae; Hippomaneae) is widespread in tropic regions of America.

Comparison with fossil woods

Paraphyllanthoxylon Bailey 1924

Numerous *Paraphyllanthoxylon* species have been described from Cretaceous aud Tertiary sediments in Europe, India, Japan, North America and South Africa. Systematic relationship of *Paraphyllanthoxylon* have been extensively discussed since 1984 (Herenden 1991, Wheeler 1991 a,b,c). Bailey (1924) chose the name to indicate a similarity in microscopic structure between a fossil wood and the Euphorbiaceae genera *Phyllanthus* and *Bridelia.* However, the relationship is somewhat uncertain because of similarities of (9-12) other families (e.g. Anacardiaceae, Burseraceae, Flacourtiaceae, Lauraceae).

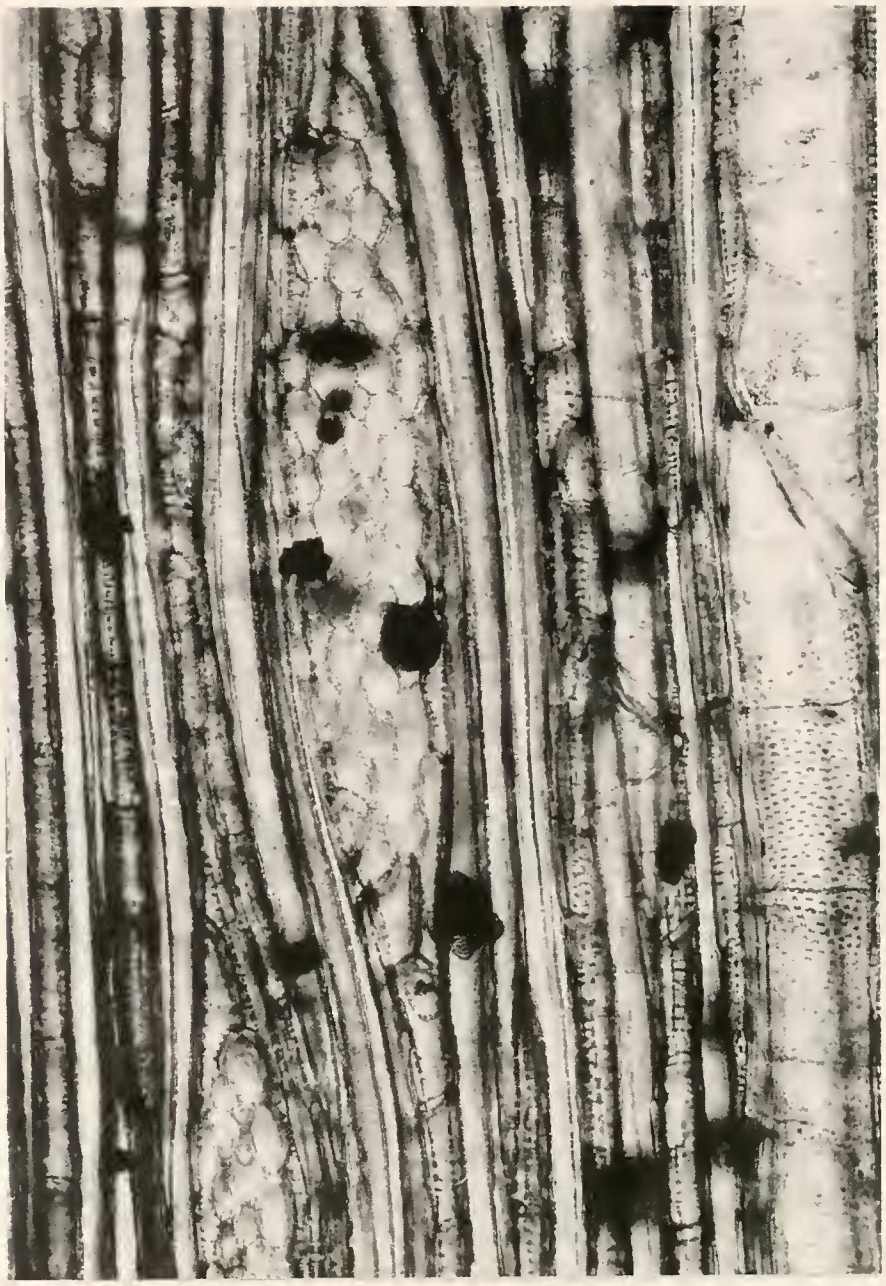

Fig. 6. Tangential section (BSP 1964 I 486).Vessels with simple perforations and crowded alternate pits, fibres nonseptate. Note: Disjunctive ray parenchyma cell walls; x 170

Paraphyllanthoxylon differs in the following qualitative features from *Euphorbioxylon ortenburgense:* vessels mostly in radial multiples, fibres septate; there is not a single record of a silicified *Paraphyllanthoxylon* wood with disjunctive ray parenchyma cell walls.

Euphorbioxylon (Felix) Mädel 1962

So far only few silicified woods of the family Euphorbiaceae are known from Europe (Greguss 1969). The combination of the antomical features exhibited by the fossil wood from Rauscheröd indicates the nearest relation to *Euphorbioxylon speciosum* (Pons 1987). The present fossil wood shares the majority of qualitative features (Tab. 1), but it differs distinctly a) in tangential diameter of vessels, b) in parenchyma frequency. One of the striking (qualitative ?) features of the present fossil wood are the disjunctive ray parenchyma cell walls. Therefore the silicified wood from Rauscheröd clearly differs mainly in 3 features from *E. speciosum* (Pons 1987) and represents a new species: *Euphorbioxylon ortenburgense* n. sp.

Fig. 7. Tangential section (BSP 1964 I 486).Vessels with simple alternate, (?) vestured pits. Note: disjunctive ray parenchyma cell walls (arrow). x 280.

41 paleogene silicified woods from the East Bavarian Molasse, locality Rauscheröd, have been identified anatomically by Gottwald (1997). With regard to the climatic demands, the comparative extant genera (Tab. 2) require exclusive tropical temperatures for their growth (Gottwald 1997: 6)

Therefore, the possible origin and fossil biotyp of these tropical woods with the new family Euphorbiaceae "are to be searched for in an Eocene coastal strip, formerly east to southeast of Ortenburg."

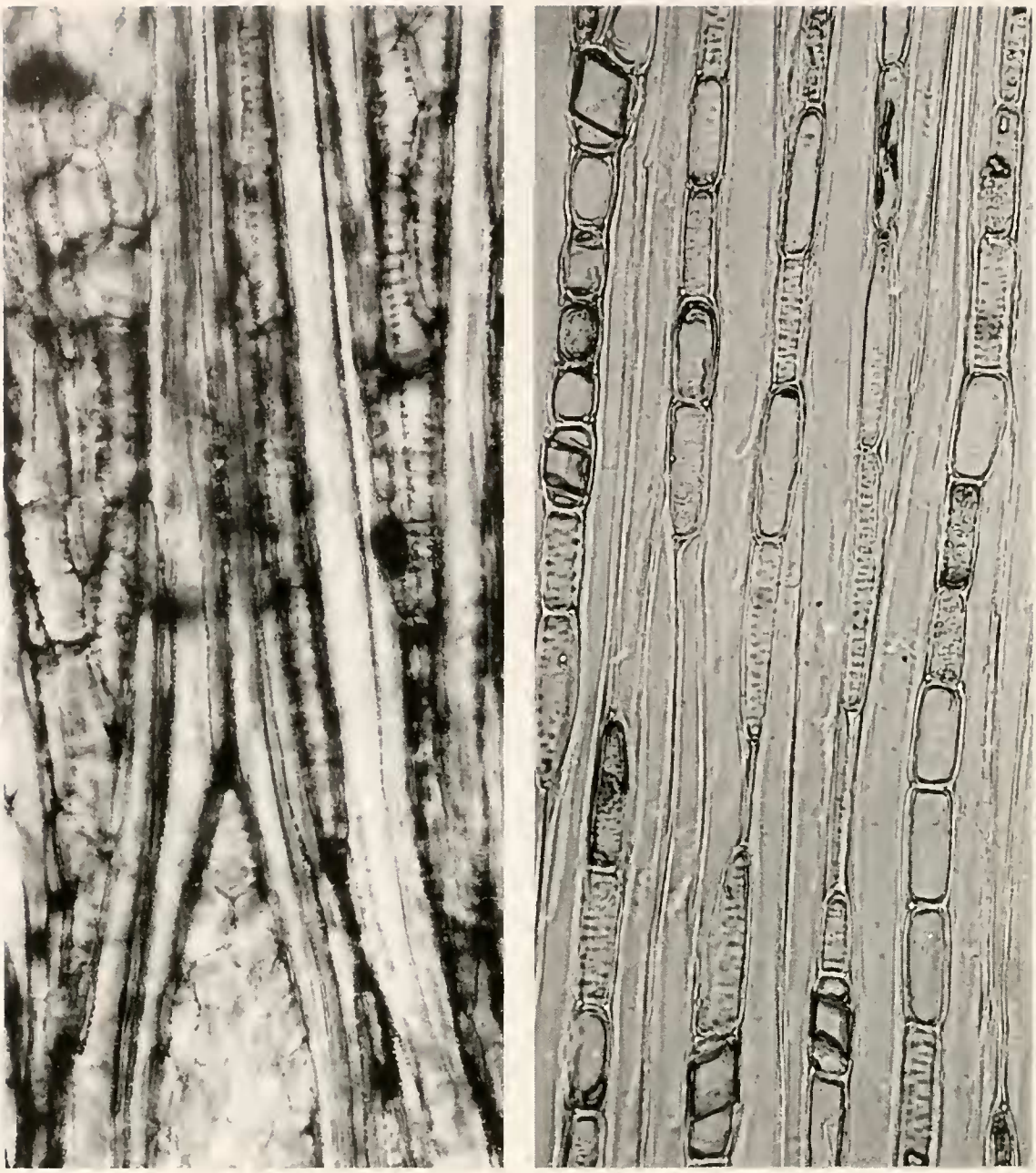

Fig. 8. Left *Euphorbioxylon ortenburgense* n. sp., right Euphorbiaceae *Sebastiana brasiliensis*, RAKF Nr. 9053, xylothec Dr. D. GROSSER, Munich. Tangential sections: Comparison of disjunctive parenchyma cell walls between the silicified and the modern wood; left x 280, right x 280

Table 1. Comparison of the fossil wood from Rauscheröd with *Euphorbioxylon* (Felix) emend. Mädel 1962.

	Euphorbioxylon speciosum Pons 1987	*Euphorbioxylon ortenburgense* n. sp.
Locality	Cretaceous of Columbia	East Bavarian Molasse
Growth rings	indistinct	indistinct
Vessels		
arrangement	diffuse-porous	diffuse-porous
groupings	solitary, 98 %	solitary
per square millimetre	mean 6-9	72
tang. diameter	mean 100-200 µm	35-56 µm
element length	mean 250-400 µm	50-161 µm
perforation	simple	simple
intervessel pits	not visible	alternate, 5 µm
vessel/-ray pitting	gash-like	gash-like
Axial parenchyma	abundant	rare or not visible
Fibres	nonseptate	nonseptate
Rays		
width	uniseriate , 2 - 6	uniserriate, 2-4(5)
heigh	max. 2,9 mm	3,4 mm
per millimetre	8-12	5-7
cellular composition	heterocellular Kribs I, IIB	heterocellular Kribs I, II B
disjunctive cell walls	**absent**	**present**

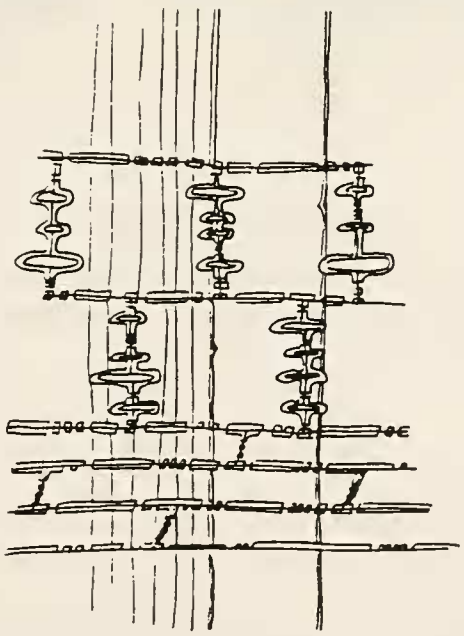

Fig. 9. Radial section. Part of a heterocellular ray. Disjunctive ray cells with tubular processes between adjacent walls in the upright cells.

Fig. 10. Radial section (BSP 1964 I 486). Vessel-ray pitting gash-like (arrow) or oval-shaped. Note: All vertical walls of the upright ray cells have disjunctive cell walls; x 360, photo D. GROSSER

Acknowledgements

Thanks are due to Dr. D. GROSSER for facilities in the xylothec and laboratory, Institute of Wood Research, University Munich. Technical assistance: H. MERTEL (thin sections), G. BERGMEIER and R. R. ROSIN (film procession, prints).

Table 2. Silicified wood samples, anatomical structure needs a tropical climate, from Lower Miocene gravel-belt „Ortenburger Schotter", Bavarian East Molasse. - Indications as to were these fossils originated are not available (GOTTWALD 1997).

	Number of woods			Extant genera	
Fossil Taxa	GOTTWALD	SELMEIER	Total	Climate	Distribution
Meliaceae					
Carapoxylon	8	46	55	tropical	Asia, Australia
Cedreloxylon	1		1	tropical	Asia, Australia
Tiliaceae					
Grewioxylon	7	19	26	tropical	Asia
Lauraceae					
Cinnamomoxylon	4	9	13	tropical	Asia
Flacourtiaceae					
Homalioxylon	1	2	3	tropical	Asia
Bombacaceae					
Bombacoxylon	3	2	5	tropical	Asia
Ebenaceae					
Euebenoxylon	1		1	tropical	Asia, Africa
Eudiospyroxylon	1		1	tropical	Asia, Africa
Euphorbiaceae					
Euphorbioxylon		1	1	tropical	Tropic ZONES
	26	79	106		

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Fig. 11. Radial section (BSP 1964 I 486). Heterocellular rays. Vertical cell walls of the procumbent (quadratic) and uprigth ray cells with disjunctive cell walls; x 170

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